

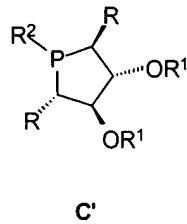
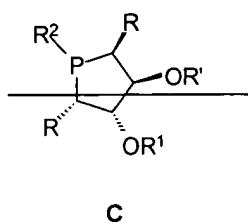
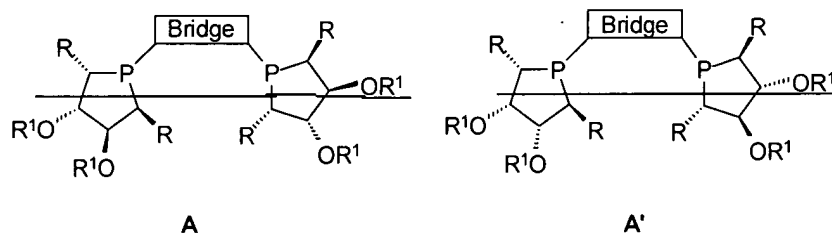
Amendments to the Claims

This listing will replace all prior versions and listings of the claims in the application:

Listing of Claims

Claims 2-7, 10, 17-22 and 35-39. (canceled)

1. (currently amended) A compound of formula A, A', C and C', or the corresponding enantiomer:

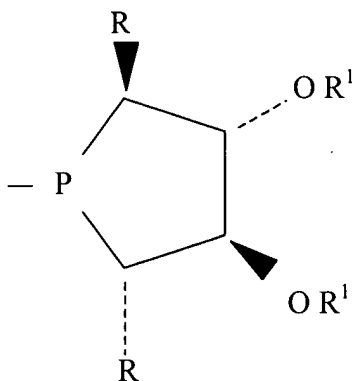


wherein:

- a) each R and R² are independently selected from the group consisting of: aryl, alkyl, alkyl aryl, aryl alkyl, or chiral oxazolono which may be substituted with carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, or diphenylphosphino groups; or wherein R² is a group having the formula:



wherein Z is a group represented by the formula:



- b) R¹ can be is selected from the group consisting of: H, alkyl, silanesilyl, aryl, a water soluble unit, or a linked polymer chain or and an inorganic support; and

- c) $\boxed{\text{Bridge}}$ may be is selected from the group consisting of:

$-(\text{CH}_2)_n-$ where n is an integer ranging from 1 to 8;

$-(CH_2)_nX(CH_2)_m-$ wherein n and m are each integers, the same or different, ranging from 1 to 8, and X is O, S, NR^4 , PR^4 , AsR^4 , SbR^4 , divalent aryl, divalent fused aryl, divalent 5-membered ring heterocyclic group, or divalent fused heterocyclic group, wherein R^4 is aryl, alkyl, substituted aryl, or substituted alkyl; or and

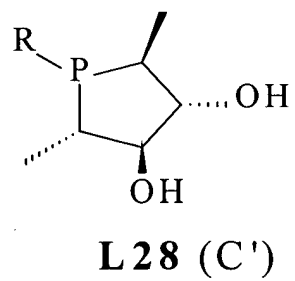
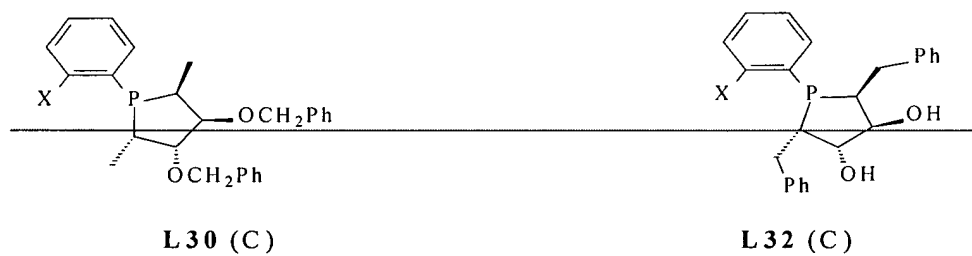
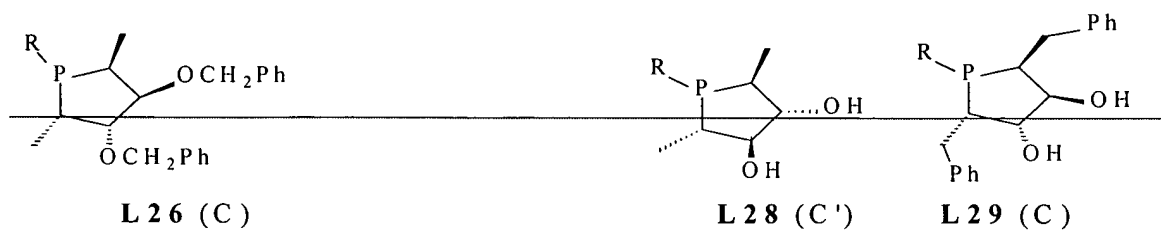
1,2-divalent phenyl, 2,2'-divalent 1,1'-biphenyl or 2,2'-divalent 1,2'-binaphthyl or ferrocene, each of which may be substituted with aryl, C1-C8 alkyl, F, Cl, Br, I, $COOR^5$, SO_3R^5 , $PO_3R^5_2$, OR^5 , SR^5 , NR^5_2 , PR^5_2 , AsR^5_2 , or SbR^5_2 ;

wherein the substitution on 1,2-divalent phenyl, the ferrocene or biaryl bridge can be independently halogen, alkyl, alkoxyl, aryl, aryloxy, nitro, amino, vinyl, substituted vinyl, alkynyl, or sulfonic acids group; and

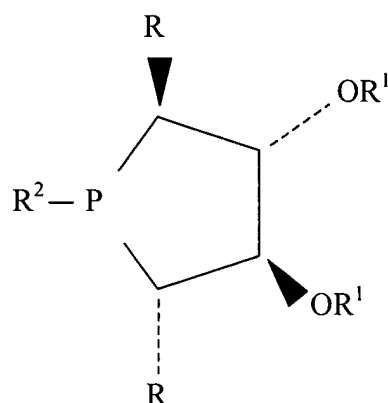
wherein R^5 is selected from the group consisting of: hydrogen, C1-C8 alkyl, C1-C8 fluoroalkyl, or C1-C8 perfluoroalkyl, aryl, substituted aryl, arylalkyl, ring-substituted arylalkyl, or and $-CR^3_2(CR^3_2)_qX(CR^3_2)_pR^1$ wherein q and p are integers, the same or different, ranging from 1 to 8; wherein R^3 is selected from the group consisting of: aryl, alkyl, substituted aryl, or and substituted alkyl; and X is as defined above.

8. (currently amended) A compound according to claim 71, wherein R is selected from the group consisting of: methyl, ethyl, cyclohexyl, or and phenyl; R' is selected from the group consisting of: hydrogen or and benzyl; R^2 is selected from the group consisting of: o-X-phenyl wherein X is hydrogen, or a carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, diphenylphosphino, or and a chiral oxazolono group.

9. (currently amended) A compound, according to claim 1, which is selected from structures L26, represented by formula L28 (C'), L29, L30 and L32, represented by the formulas:



11. (currently amended) A compound according to claim 1 having the following formula or ~~its~~ the corresponding enantiomer:



wherein:

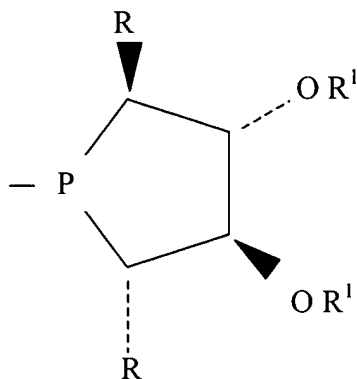
- A) each R is each selected from the group consisting of: C₁-C₈ alkyl, C₁-C₈ alkyl aryl, aryl C₁-C₈ alkyl, aryl, each of which may be substituted with carboxylic acid, alkoxy, hydroxy, C₁-C₈ alkylthio, thiol, dialkylamino, or diphenylphosphino, or chiral oxazoline; and
- B) ~~R¹ is~~ each R¹ is selected from the group consisting of: H, C₁-C₈ alkyl, silane, aryl, a water soluble unit, ~~or a linked polymer chain or~~ and linked inorganic support; and
- C) R² is either R, H, or a ~~symmetrical bidentate structure~~ group having the formula:



wherein $\boxed{\text{BRIDGE}}$ is selected from the group consisting of:

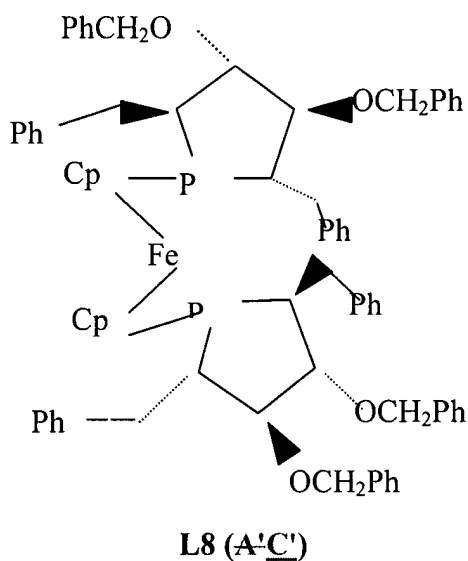
- i) $-(\text{CH}_2)_n-$ where n is an integer from 1 to 8;
or

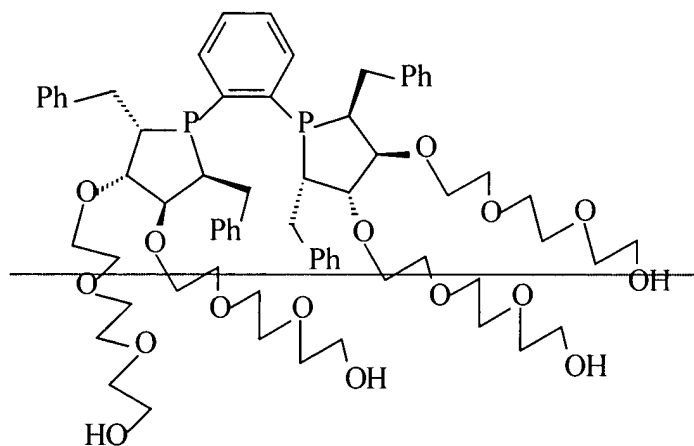
- ii) $-(CH_2)_n X (CH_2)_m-$ where n and m are the same or different integers from 1 to 8, and X is O, S, NR^4 , PR^4 , AsR^4 , SbR^4 , divalent aryl, divalent fused aryl, divalent 5-membered heterocyclic ring, or divalent fused heterocyclic ring, where R^4 is C^1 - C^8 alkyl, aryl, substituted aryl, or substituted C_1 - C_8 alkyl; or
- iii) 1, 2-divalent phenyl, 2, 2'-divalent 1,1'biphenyl, 2,2'-divalent, 1,1' binaphthyl, or ferrocene, each of which may be substituted independently with $C_1 - C_8$ alkyl or aryl, F, Cl, Br, I, $COOR^5$, SO_3R^5 , PO_3R^5 , OR^5 , SR^5 , NR^5 , PR^5 , AsR^5 , SbR^5 , nitro, vinyl, substituted vinyl, alkynyl wherein R^5 is H, C_1 - C_8 alkyl, substituted C_1 - C_8 alkyl, C_1 - C_8 fluoroalkyl, C_1 - C_8 perfluoroalkyl, aryl or substituted aryl; and
- wherein Z is a compound selected from the group of compounds having the following formula and its enantiomer~~their~~ corresponding enantiomers:



12. (currently amended) A compound according to claim 11, wherein R is selected from the group consisting of: methyl, ethyl, or benzyl; R¹ is selected from the group consisting of: hydrogen ~~or~~and benzyl, and BRIDGE is selected from the group consisting of: —(CH₂)_n— where n is an integer from 1 to 3; 1,2- divalent phenyl, 2,2' divalent 1,1' biphenyl, 2,2'-divalent 1,2' binaphthyl, ~~or~~and ferrocene, each of which may be substituted with C₁-C₃ alkyl or OR⁵, wherein R⁵ is methyl or ethyl.

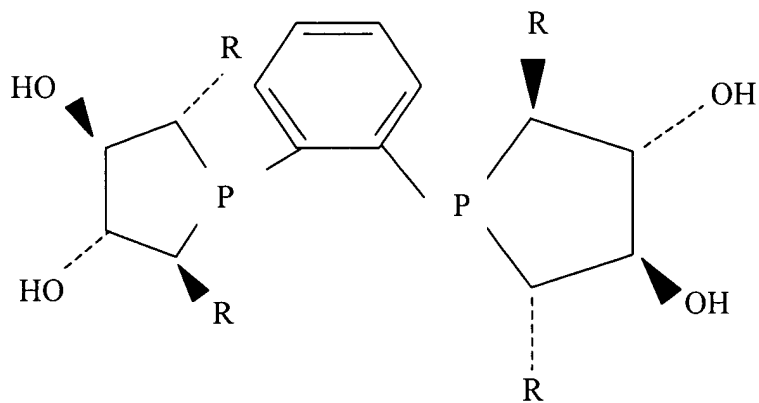
13. (currently amended) A compound according to claim 11, selected from the group of compounds of represented by the following formulas
formula or its enantiomer; and their corresponding enantiomers:





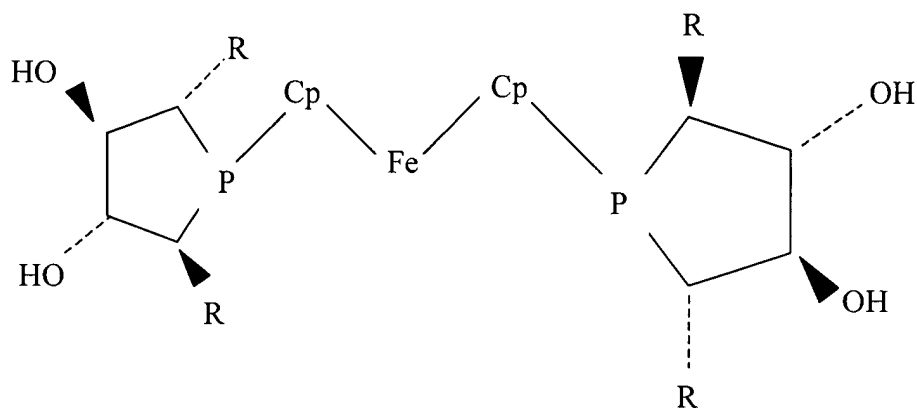
L21 (A)

14. (currently amended) A compound according to claim 11, selected from the group of compounds of the following formulas ~~and their corresponding enantiomers~~ wherein R is either methyl or ethyl and its enantiomer:



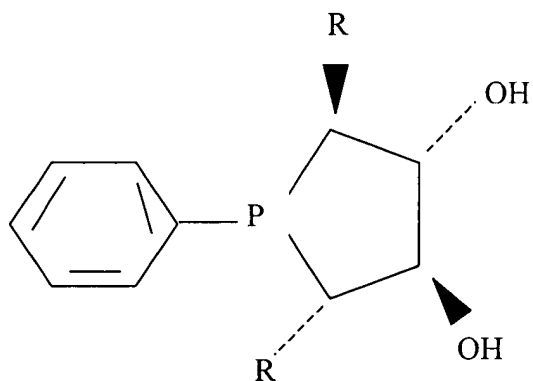
wherein R is methyl or ethyl.

15. (currently amended) A compound according to claim 11 selected from the group of compounds of the following formulas ~~and their corresponding enantiomers~~ wherein R is either methyl or ethyl and its enantiomer:

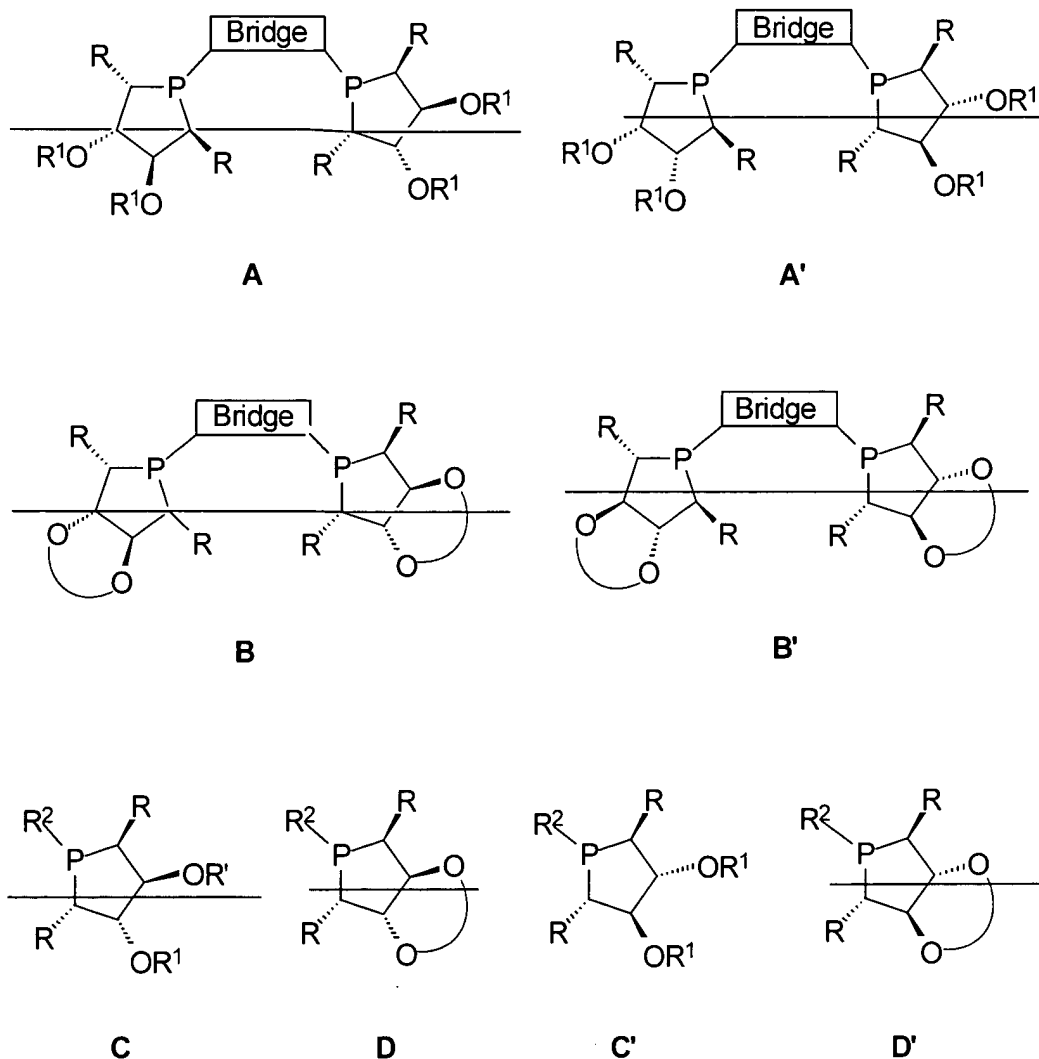


wherein R is either methyl or ethyl.

16. (currently amended) A compound according to claim 11 selected from the group of compounds of the following formula ~~and their corresponding enantiomers~~ and its enantiomer:



23. (currently amended) A catalyst comprising a compound in the form of a complex with a transition metal wherein said compound is selected from compounds represented by the formula:



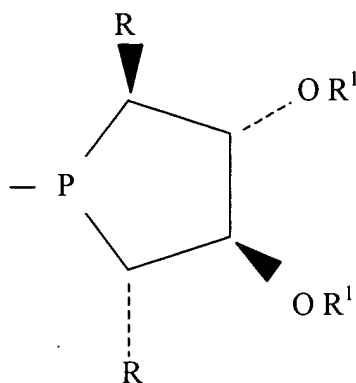
wherein:

a) each R and R² is independently selected from the group consisting of: aryl, alkyl, alkyl aryl, aryl alkyl, chiral oxazolino which may be substituted with carboxylic acid, alkoxy, hydroxy,

alkylthio, thiol, dialkylamino, or diphenylphosphino groups; or wherein R^2 is a group having the formula:



wherein Z is a group represented by the formula:



b) R^1 is selected from the group consisting of: H, alkyl, silyl, aryl, a water soluble unit, a linked polymer chain and an inorganic support; and

c) $\boxed{\text{Bridge}}$ is selected from the group consisting of:

$-(CH_2)_n-$ where n is an integer ranging from 1 to 8;

$-(CH_2)_nX(CH_2)_m-$ wherein n and m are each integers, the same or different, ranging from 1 to 8, and X is O, S, NR^4 , PR^4 , AsR^4 , SbR^4 , divalent aryl, divalent fused aryl, divalent 5-membered ring heterocyclic group, or divalent fused heterocyclic group, wherein R^4 is aryl, alkyl, substituted aryl, or substituted alkyl; and

1,2-divalent phenyl, 2,2'-divalent 1,1'-biphenyl or 2,2'-divalent 1,2'-binaphthyl or ferrocene, each of which may be substituted with aryl, C1-C8 alkyl, F, Cl, Br, I, $COOR^5$, SO_3R^5 , $PO_3R^5_2$, OR^5 , SR^5 , NR^5_2 , PR^5_2 , AsR^5_2 , or SbR^5_2 ;

wherein the substitution on 1,2-divalent phenyl, the ferrocene or biaryl

bridge can be independently halogen, alkyl, alkoxyl, aryl, aryloxy, nitro, amino, vinyl, substituted vinyl, alkynyl, or sulfonic acid group; and

wherein R^5 is selected from the group consisting of: hydrogen, C1-C8 alkyl, C1-C8 fluoroalkyl, C1-C8 perfluoroalkyl, aryl, substituted aryl, arylalkyl, ring-substituted arylalkyl, and $-CR^3_2(CR^3_2)_qX(CR^3_2)_pR^1$ wherein q and p are integers, the same or different, ranging from 1 to 8; wherein R^3 is selected from the group consisting of: aryl, alkyl, substituted aryl, and substituted alkyl; and X is as defined above.

24. (currently amended) A catalyst according to claim 23, wherein the transition metal is selected from the group consisting of: rhodium, iridium, ruthenium, nickel, ~~or~~ and palladium.

25. (currently amended) A catalyst according to claim 24, wherein said compound is a complex with a compound selected from the group consisting of:

_____ $Pd_2(DBA)_3$, $Pd(OAc)_2$, $[Rh(COD)Cl]_2$, $[Rh(COD)_2]X$, $Rh(acac)(CO)_2$, $RuCl_2(COD)$, $Ru(COD)(methylallyl)_2$, $Ru(Ar)Cl_2$, wherein Ar is an aryl group, unsubstituted or substituted with an alkyl group; $[Ir(COD)Cl]_2$, $[Ir(COD)_2]X$; and $Ni(allyl)X$; wherein X is a counterion.

26. (currently amended) A catalyst according to claim 25, wherein X is selected from the group consisting of: F^- , F^- , Cl^- , Br^- , I^- , BF_4^- , ClO_4^- , SbF_6^- , $CF_3SO_3^-$, and PF_6^- .

27. (currently amended) A catalyst according to claim 26, wherein X is PF_6^- .

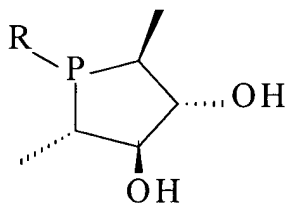
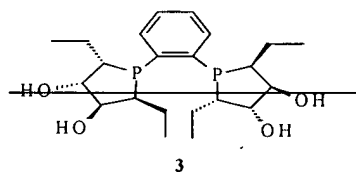
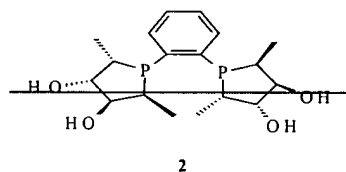
28. (currently amended) A catalyst according to claim 24, wherein the transition metal is Ru or Rh.

29. (currently amended) A catalyst according to claim 28, wherein the

transition metal is Rh.

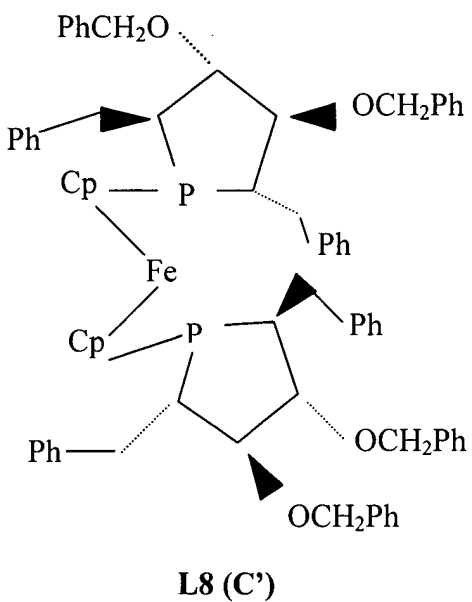
30. (currently amended) A catalyst according to claim 23, wherein the catalyst ~~comprises~~ is prepared from: $\text{Ru}(\text{RCOO})_2(\text{diphosphine})$, $\text{RuX}_2(\text{diphosphine})$, $\text{Ru}(\text{methylallyl})_2(\text{diphosphine})$, $\text{Ru}(\text{aryl group})\text{X}_2(\text{diphosphine})$, $\text{Rh}(\text{RCOO})_2(\text{diphosphine})$, $\text{RhX}_2(\text{diphosphine})$, $\text{Rh}(\text{methylallyl})_2 \text{ diphosphine}$, or $\text{Rh}(\text{aryl group})\text{X}_2 (\text{diphosphine})$ and X is halogen.

31. (currently amended) A catalyst according to claim 23 for asymmetric hydrogenation of a ketone, imine, or olefin, comprising: a complex of compounds **2** L28 (C') or **3** L8 (C') with a Rh compound selected from the group consisting of: $[\text{Rh}(\text{COD})\text{Cl}]_2$ and $[\text{Rh}(\text{COD})_2]\text{X}$, wherein X is selected from the group consisting of: BF_4 , ClO_4 , SbF_6 , CF_3SO_3^- :

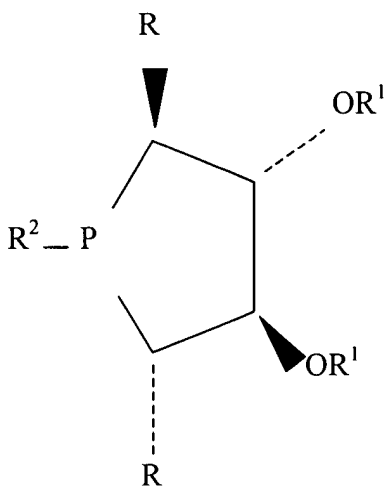


L28 (C')

or



32. (currently amended) A catalyst according to claim 23 comprising a transition metal complex of a compound of the following formula or its enantiomer:



wherein:

(A) each R is each selected from the group consisting of: C₁-C₈ alkyl, C₁-C₈ alkyl aryl, aryl C₁-C₈ alkyl, aryl, each of which may be substituted with carboxylic acid, alkoxy, hydroxy, C₁-C₈ alkylthio, thiol, dialkylamino, or diphenylphosphino, ~~or~~ and chiral oxazoline; and

(B) R¹ is ~~each~~ selected from the group consisting of: H, C₁-C₈ alkyl, silane, aryl, a water soluble unit, ~~or~~ a linked polymer chain and ~~or~~ linked inorganic support; and

(C) R² is either R, H, or a ~~symmetrical bidentate structure~~ group having the formula:



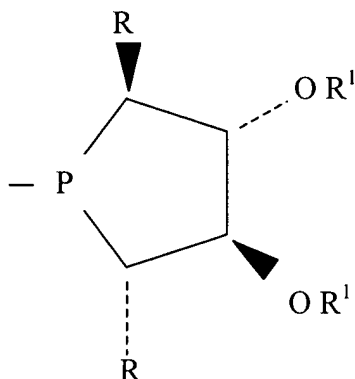
wherein $\boxed{\text{BRIDGE}}$ is selected from the group consisting of:

(i) $-(\text{CH}_2)_n-$ where n is an integer from 1 to 8; or

(ii) $-(\text{CH}_2)_n \text{X} (\text{CH}_2)_m-$ where n and m are the same or different integers from 1 to 8, and X is O, S, NR⁴, PR⁴, AsR⁴, SbR⁴, divalent aryl, divalent fused aryl, divalent 5-membered heterocyclic ring, or divalent fused heterocyclic ring, where R⁴ is C¹-C⁸ alkyl, aryl, substituted aryl, or substituted C₁-C₈ alkyl; or

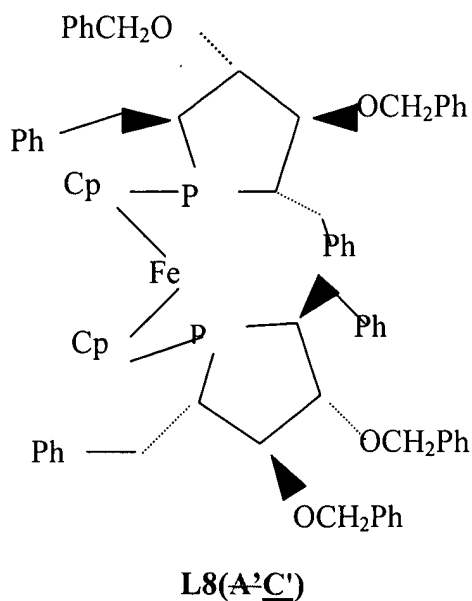
(iii) 1, 2-divalent phenyl, 2, 2'-divalent 1, 1'-biphenyl, 2,2'-divalent, 1,1' binaphthyl, or ferrocene, each of which may be substituted independently with C₁ – C₈ alkyl or aryl, F, Cl, Br, I, COOR⁵, SO₃R⁵, PO₃R⁵₂, OR⁵, SR⁵, NR⁵₂, PR⁵₂, AsR⁵₂, SbR⁵₂, nitro, vinyl, substituted vinyl, alkynyl wherein R⁵ is H, C₁-C₈ alkyl, substituted C₁-C₈ alkyl, C₁-C₈ fluoroalkyl, C₁-C₈ perfluoroalkyl, aryl or substituted aryl; and

wherein Z is a compound selected from the group of compounds having the following formula ~~and their corresponding enantiomers~~ and its enantiomer:



33. (original) A catalyst according to claim 23, wherein each R^1 is independently selected from the group consisting of: methyl and ethyl groups.

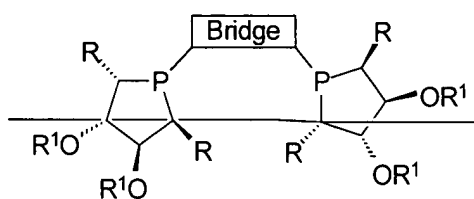
34. (currently amended) A catalyst according to claim 23, wherein the transition metal complex is derived from a compound of the following formula or its enantiomer:



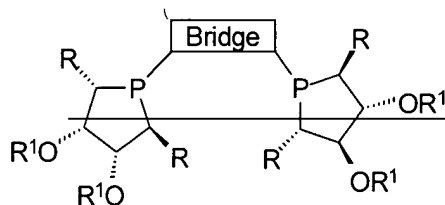
and wherein the transition metal is selected from the group consisting of:
rhodium, iridium, ruthenium, nickel, and palladium.

40. (currently amended) A process for preparation of a non-racemic compound from a substrate, comprising the step of:

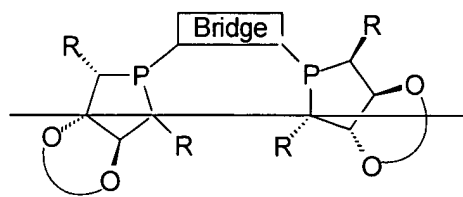
subjecting said substrate to an asymmetric reaction in the presence of a non-racemic catalyst comprising a chiral ligand represented by the formula A, A', B, B', C, C', D, or D', or the corresponding enantiomer:



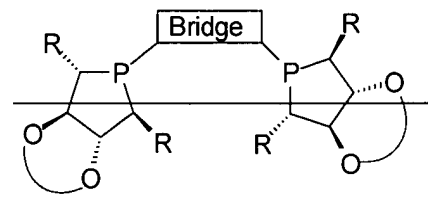
A



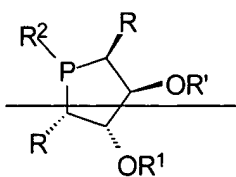
A'



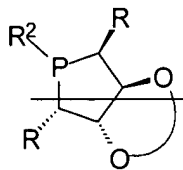
B



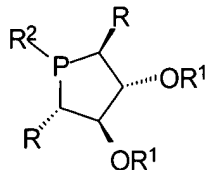
B'



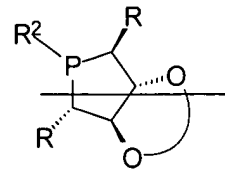
C



D



C'



D'

wherein:

- a) ~~R and R² are independently aryl, alkyl, alkyl aryl, aryl alkyl, or chiral oxazolono which may be substituted with carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, or diphenylphosphino groups;~~
- b) ~~R¹ can be H, alkyl, silane, aryl, a water soluble unit, or a linked polymer chain or inorganic support;~~
- c) ~~the ring component $\text{O}-\text{O}$ represents a protected diol, a crown ether linkage, $\text{O}-\text{alkyl}-\text{O}$ wherein the alkyl group is linked to a polymer, or $-\text{O}-(\text{CH}_2\text{CH}_2-\text{O})_n$ wherein n is an integer ranging from 1 to 8 and the methylene groups are optionally substituted by C1-C8 alkyl; and~~
- d)

Bridge

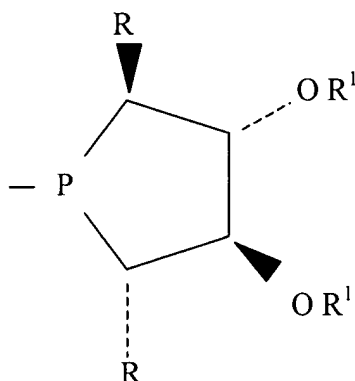
~~may be:~~
- ~~$-(\text{CH}_2)_n$ where n is an integer ranging from 1 to 8;~~
- ~~$-(\text{CH}_2)_n\text{X}(\text{CH}_2)_m$ wherein n and m are each integers, the same or different, ranging from 1 to 8, and X is O, S, NR⁴, PR⁴, AsR⁴, SbR⁴, divalent aryl, divalent fused aryl, divalent 5-membered ring heterocyclic group, or divalent fused heterocyclic group, wherein R⁴ is aryl, alkyl, substituted aryl, or substituted alkyl; or~~
- ~~1,2-divalent phenyl, 2,2'-divalent 1,1'-biphenyl or 2,2'-divalent 1,2'-binaphthyl or ferrocene, each of which may be substituted with aryl, C1-C8 alkyl, F, Cl, Br, I, COOR⁵, SO₃R⁵, PO₃R⁵, OR⁵, SR⁵, NR⁵, PR⁵, AsR⁵, or SbR⁵ wherein:~~
- ~~the substitution on 1,2-divalent phenyl, the ferrocene or biaryl bridge can be independently halogen, alkyl, alkoxy, aryl, aryloxy, nitro, amino, vinyl, substituted vinyl, alkynyl, or sulfonic acids; and~~
- ~~R⁵ is hydrogen, C1-C8 alkyl, C1-C8 fluoroalkyl, or C1-C8 perfluoroalkyl, aryl, substituted aryl, arylalkyl, ring-substituted arylalkyl; or $-\text{CR}^3_2(\text{CR}^3_2)_q\text{X}(\text{CR}^3_2)_p\text{R}^1$ wherein q and p are integers, the same or different, ranging from 1 to 8; R³ is aryl, alkyl, substituted aryl, or substituted alkyl; and X is as defined above;~~

wherein:

a) each R and R² is independently selected from the group consisting of: aryl, alkyl, alkyl aryl, aryl alkyl, chiral oxazolino which may be substituted with carboxylic acid, alkoxy, hydroxy, alkylthio, thiol, dialkylamino, or diphenylphosphino groups; or wherein R² is a group having the formula:



wherein Z is a group represented by the formula:



b) R¹ is selected from the group consisting of: H, alkyl, silyl, aryl, a water soluble unit, a linked polymer chain and an inorganic support; and

c) $\boxed{\text{Bridge}}$ is selected from the group consisting of:

-(CH₂)_n- where n is an integer ranging from 1 to 8;

-(CH₂)_nX(CH₂)_m- wherein n and m are each integers, the same or different, ranging from 1 to 8, and X is O, S, NR⁴, PR⁴, AsR⁴, SbR⁴, divalent aryl, divalent fused aryl, divalent 5-membered ring heterocyclic group, or divalent fused heterocyclic group, wherein R⁴ is aryl, alkyl, substituted aryl, or

substituted alkyl; and

1,2-divalent phenyl, 2,2'-divalent 1,1'biphenyl or 2,2'-divalent 1,2'-binaphthyl or ferrocene, each of which may be substituted with aryl, C1-C8 alkyl, F, Cl, Br, I, COOR⁵, SO₃R⁵, PO₃R⁵₂, OR⁵, SR⁵, NR⁵₂, PR⁵₂, AsR⁵₂, or SbR⁵₂;

wherein the substitution on 1,2-divalent phenyl, the ferrocene or biaryl bridge can be independently halogen, alkyl, alkoxy, aryl, aryloxy, nitro, amino, vinyl, substituted vinyl, alkynyl, or sulfonic acid group; and

wherein R⁵ is selected from the group consisting of: hydrogen, C1-C8 alkyl, C1-C8 fluoroalkyl, C1-C8 perfluoroalkyl, aryl, substituted aryl, arylalkyl, ring-substituted arylalkyl, and $-\text{CR}^3_2(\text{CR}^3_2)_q\text{X}(\text{CR}^3_2)_p\text{R}^1$ wherein q and p are integers, the same or different, ranging from 1 to 8; wherein R³ is selected from the group consisting of: aryl, alkyl, substituted aryl, and substituted alkyl; and X is as defined above; and

wherein said asymmetric reaction is selected from the group consisting of: a hydrogenation, hydride transfer, hydrosilylation, hydroboration, hydrovinylation, olefin metathesis, hydroformylation, hydrocarboxylation, allylic alkylation, cyclopropanation, Diels-Alder, Aldol, Heck [m + n] cycloaddition, ~~or~~ and Michael addition reaction.

41. (currently amended) A process according to claim 40, wherein said asymmetric reaction ~~comprises~~ is asymmetric hydrogenation of a ketone, imine, enamide, or olefin.

42. (currently amended) A process according to claim 40, wherein said asymmetric reaction ~~comprises~~ is Rh(I)-catalyzed hydrogenation of a dehydroamino acid or an ester thereof.